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(54) Bevel Gear Drive

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ASSEMBLY WITH IMPROVED BEVEL GEAR ALIGNMENT

Background of the Invention

This invention relates to bevel gear drive assemblies. In a bevel gear drive assembly, it is customary in some applications for a housing to contain a plurality of bevel gears in cooperative communication partially submerged in a lubrication oil. End caps are provided to enable access to the interior of the housing to facilitate assembly and repair of the bevel gear drive assembly.

A bevel gear drive assembly is susceptible to wear necessitating repair of the drive assembly. And, since the drive assembly is generally employed as an integral part of an overall power train, repair of the drive assembly can represent a not insubstantial amount of system downtime. Therefore, decreasing the frequency of needed repair or replacement of the drive assembly inevitably represents a decrease in system downtime representing economic benefit.

The wear characteristic of the housed bevel gears is influenced substantially by the relative alignment of the meshed bevel gears. It is customary to fixably mount the bevel gears on a respective shaft, the shafts being rotatably supported within the housing. The shafts are generally rotatably supported at one of the support locations by a respective end cap. It is customary to provide compressible gaskets at critical locations such that the bevel gear location can be indexed by torquing down the respective end caps to the housing. The compressible gaskets also function as seals.

Over time, the gasket recedes allowing the respective shafts to develop end play. As a result of shaft end play, the resulting bevel gear play decreases the gear lift. Further receding and weathering of the gaskets promotes leakage of lubricating fluid from the housing, requiring frequent replenishment.

Summary of the Invention

It is therefore an objective of the present invention to present a bevel gear drive assembly which has improved bevel gear alignment characteristics. It is a further objective of the present invention to present a bevel gear drive assembly which does not employ compressible gaskets.

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The bevel gear drive assembly includes a housing rotatably supporting a first shaft transversely therein. The first shaft is rotatably supported at one end in the housing by a conventional bearing. A first bevel gear is keyed or splined to the first shaft in fixed location relative to the housing. The mounting arrangement of the first shaft and first bevel gear within the housing fixably locates the first bevel gear position relative to the housing. A first end cap is bolted to the housing and rotatably supports another portion of said first shaft within a bearing assembly. A load ring is positioned within the first end cap bearing seat such that the shaft will experience zero end play. An O-ring seal and metallic shim are placed between a respective portion of the end cap and housing for sealing.

A second shaft is rotatably supported in a second end cap fixably mounted to the housing such that the second shaft is oriented generally perpendicular to the first shaft. Sealing between the second end cap and the housing employs a sealing O-ring seal. A second bevel gear is keyed or splined to the second shaft at one end in fixed location. The second bevel gear is in constant mesh with the first bevel gear.

Brief Description of the Drawing

FIG. 1 is a sectioned elevated view of a bevel gear assembly in accordance with the present invention.

Description of the Preferred Embodiment

Referring to the FIG. 1, a bevel gear assembly, generally indicated as 11, includes a housing 13 having a plurality of channeled openings 17, 19 and 21. Openings 17 and 19 are concentric along centerline A in opposite walls of housing 13. Opening 21 is located in the housing wall to have a centerline B extension generally perpendicular to the concentric centerline A of openings 17 and 19.

Within opening 17, a bearing seat 23 is formed in housing 13. Pressed within bearing seat 23 is a conventional bearing assembly 25. A first shaft 27 journeys through the opening 19 having a portion received in bearing assembly 25. The shaft 27 may journey beyond bearing assembly 25 as indicated in figure 1 in phantom. Further, opening 17 need not extend entirely through the housing 13 when the shaft 17 is not required to journey beyond the housing 13.

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A shim 29 is placed around the shaft 27 abutting to the bearing assembly 25 within housing 13. A first bevel gear 31 is mounted within the housing 13 abutting to shim 29 around and keyed to shaft 27 at 33. The shim 29 effects the location of bevel gear 31, i.e., the location of bevel gear 31 relative to the housing may be adjusted by the selection of the shim 29 thickness. A snap ring 35 is received in an annular recess 36 around shaft 27 to restrain longitudinal motion of bevel gear 31 in a conventional manner. The mounting of shaft 27 and bevel gear 31 fixably locates or positions the bevel gear 31 relative to the housing 13.

An end cap, generally indicated as 37, is received within opening 19 around another portion of shaft 27. The end cap 37 has a hole 39 therein through which the shaft 27 journeys. Within the hole 39 is formed a bearing seat 41. A conventional bearing assembly 43 is pressed into bearing seat 41 following a load ring 72 to rotatably support shaft 27. A snap ring 45 is received by the shaft 27 in a conventional manner abutting to bearing assembly 43. The end cap 37 has a flanged portion 48 which is fixably mounted to the housing 13 by a plurality of bolts 51 in a conventional manner. An O-ring seal 47 is seated within an annular recess 46 in end cap 37 and abuts the housing portion defining opening 19. A metal shim 49 is sandwiched between the housing 13 and the end cap flange 48. A sealing cover 53 is placed in opening 17 and a sealing cover 55 is placed in hole 39. It is noted that the thickness of shim 49 is set by the deflection specification of the load ring 72. The load ring 72 is thereby able to compensate for all manufacturing tolerances and achieve zero end play of shaft 27. As a result, the bevel gear 31 is in a fixed location relative to the housing 13.

Within opening 21 is located an end cap 57. A sealing ring 59 is seated within an annular recess 60 between the end cap 57 and housing portion defining the opening 21. The end cap 57 has a channeled opening 63 with a first bearing seat 65 formed within opening 63. A shaft 67 journeys into the opening 63 having a threaded end portion 68 located inward to the housing. The shaft 67 carries a second bevel gear 69 keyed to one end of the shaft 67 at 71. A torque nut 73 preceded by a washer abutting to one end of bevel gear 69 is threadably mounted to

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shaft portion on 68. The base 74 of bevel gear 69 is pressed mounted into a bearing assembly 75 residing in bearing seat 65. A shim 76 is placed between the bearing assembly 75 and bevel gear 69 around the base 74 locating the bevel gear 69. The bevel gear 69 is in constant mesh with the first bevel gear 31. A second conventional bearing assembly 77 rotatably supports the shaft 67 at a location along shaft 67 within the end cap opening 63. The bearing assembly 77 is restrained within opening 63 from longitudinal motion to the left by snap ring 79 set in end cap 57 within opening 63 in an annular recess 80 and to the right by snap ring 81 set within an annular recess 80 and to the right by snap ring 81 set within an annular recess 82 formed in shaft 67 in a conventional manner. A sealing cover 83 is press mounted in the mouth of opening 63 around shaft 67.

It is by now appreciated by one reasonably skilled in the art, that the present invention allows for the achievement of zero end play of the shaft 27. That is, the cross-sectional length of the load ring 72 exceeds the space requirements such that torquing of the end cap screws 51 places the load ring 72 in compression, thereby compensating for manufacturing tolerance buildup. The shim 49 allows the space requirements of the load ring to be adjusted within the compression range of the load ring 72. It is further appreciated that by the selection of the shim thickness for shims 29 and 76, the optimum position relationship between bevel gears 31 and 69 can be achieved. It is noted the absence of any compressible gasket allows the position relationship between bevel gears 31 and 69 to be enduring. And, further, the absence of compressible gaskets removes a lubrication leakage median from the bevel gear assembly 11, sealing between the end caps and housing being facilitated by seated O-rings.

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The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a bevel gear assembly having an enclosure housing with at least a first and second opening, first and second end caps fixably mounted to said housing over respective ones of said openings, a first shaft having a first bevel gear drivingly mounted therearound, said first shaft being rotatably mounted in said housing such that said first bevel gear is located therein and having a portion of said first shaft extending through and rotatably supported in said first end cap; and a second shaft having a second bevel gear drivingly mounted therearound, said second shaft being rotatably mounted in said second end cap and having said second bevel gear drivingly mounted therearound located in said housing in constant mesh with said first bevel gear, wherein the improvement comprises;

first means for restraining longitudinal motion of said first bevel gear and positively locating said bevel gear relative to said housing including,

said housing having a formed first bearing seat,

a first bearing seatably received in said first bearing seat, a portion of said first shaft journalled in said first bearing, a first shim placed around said first shaft and abutting to said first bearing, said first bevel gear being drivingly mounted to said first shaft longitudinally locating said shim between said first bearing and said first bevel gear, and a snap ring fixably mounted around said first shaft abutting to a portion of said first bevel gear;

said first end cap including a hole therethrough, a second bearing seat formed central to a portion of said hole, a second bearing mounted in said second bearing seat, a load ring sandwiched in said second bearing seat abutting to said second bearing such that said load ring is placed in compression by said second bearing and a second snap ring fixably mounted to said first shaft abutting to said second bearing to restrain independent longitudinal motion of said second bearing whereby said reaction loading of said load ring on said second bearing acting through said second snap ring causes said first bevel gear to maintain a fixed longitudinal location relative to said housing predicated on the thickness of said first shim.

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2. In a bevel gear assembly as claimed in claim 1 further comprising means of selectively setting the compression load of said load ring including a second shim sandwiched between said housing and said first end cap, said second shim thickness to be within the deflection range of said load ring.

3. In a bevel assembly as claimed in claim 1 or 2, wherein said second end cap is fixably and detachably mounted to said housing in said second opening and having an elongated cylindrical opening extending through said second end cap, a third bearing assembly seated in said opening of said second end cap; said second shaft having said second bevel gear drivingly mounted thereto at one end internal to said housing, a torque nut, a washer, said torque nut being fixably and adjustably mounted to one end of said second shaft having said washer abutting a base portion of said second bevel gear, said bevel gear base portion being received in and abuts a portion of said third bearing assembly, and a third shim longitudinally sandwiched between said second bevel gear and said third bearing, whereby the thickness of said third shim effects the longitudinal location of said second bearing and whereby selecting appropriate thickness of said first and third shim allows optimum cooperative positioning of said first and second bevel gears relative to said housing.

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ASSEMBLY WITH IMPROVED BEVEL GEAR ALIGNMENT

Abstract of the Disclosure

A bevel gear drive includes a housing having at least a first and second opening. An end cap is fixably mounted in each of the respective openings, sealing between the end caps and the housing being provided by O-rings. A first shaft is rotatably mounted in one of said end caps in a fixed longitudinal position. A driving bevel gear is drivenly mounted around the first shaft in specific location relative to the centerline of the second opening, the location of the driving bevel gear being specifically located by the thickness of a shim adjacent to the base of the bevel gear. A second shaft is rotatably mounted at one location in a bearing seated in the housing. A driven bevel gear is drivenly mounted to the second shaft and is axially located by a second shim between the bearing and base of the driven gear. The specific location of the driven gear relative to the first opening is determined by a shim thickness. The second shaft is also rotatably supported at a second location and the support includes means of maintaining the longitudinal placement of the driven gear.

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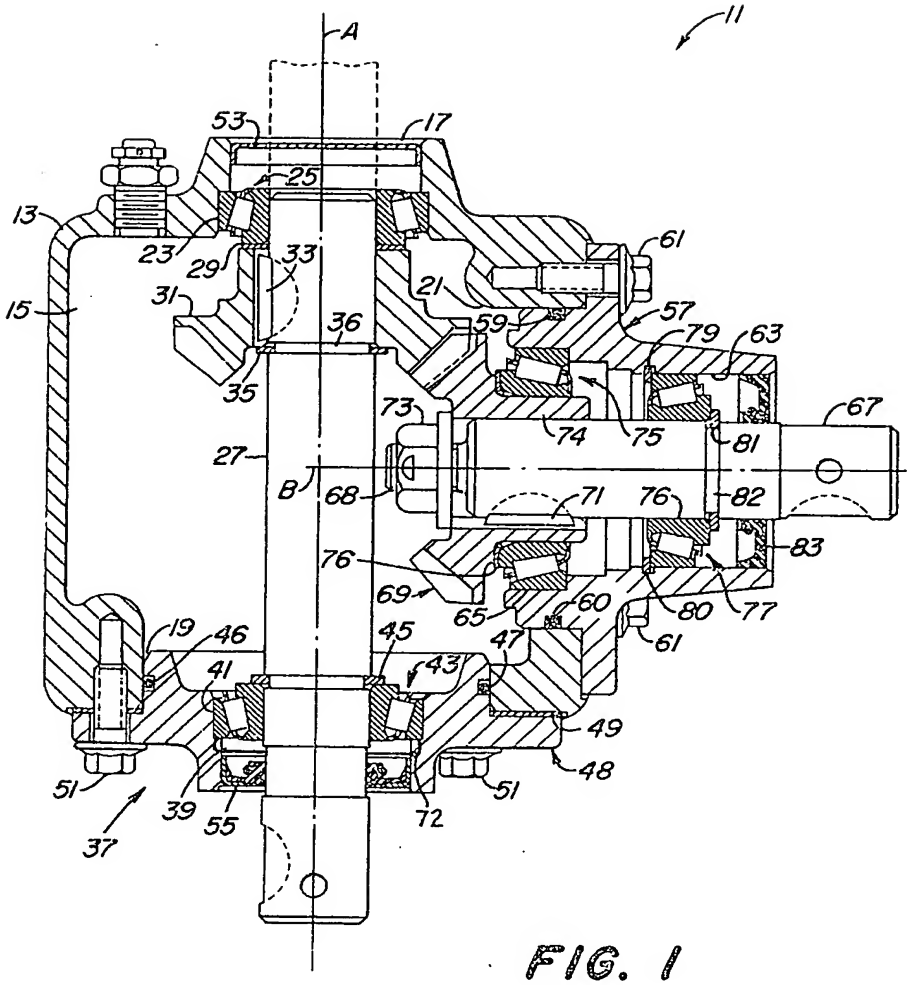

FIG. 1

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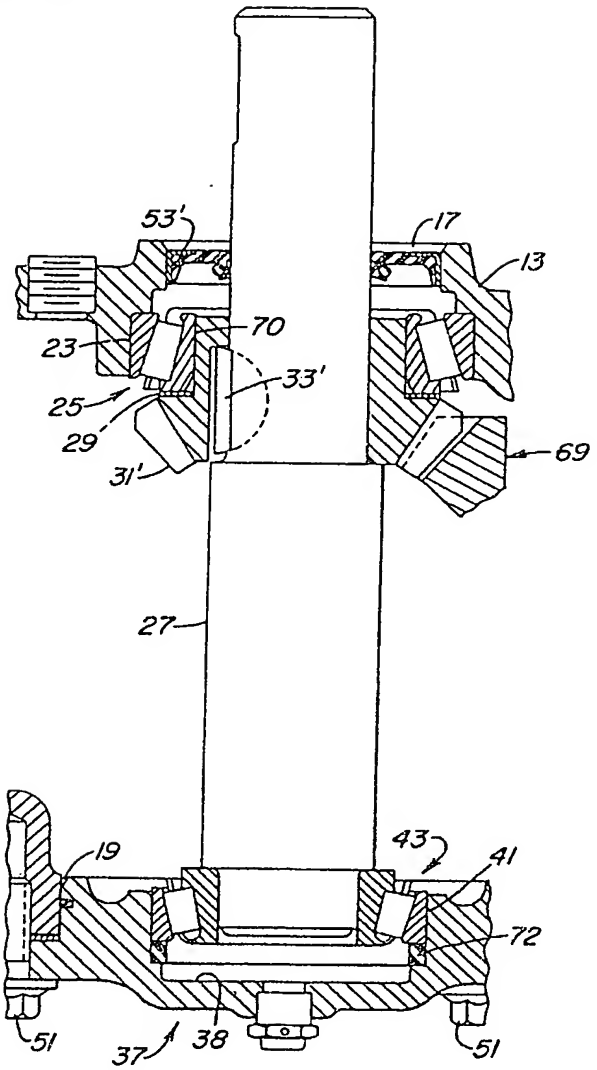
FIG. 2



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